



# STGP3NB60HD STGP3NB60HDFP

N-CHANNEL 3A - 600V TO-220/FP  
PowerMESH™ IGBT

TYPE	V <sub>CES</sub>	V <sub>CE(sat)</sub>	I <sub>C</sub>
STGP3NB60HD	600 V	< 2.8 V	3 A
STGP3NB60HDFP	600 V	< 2.8 V	3 A

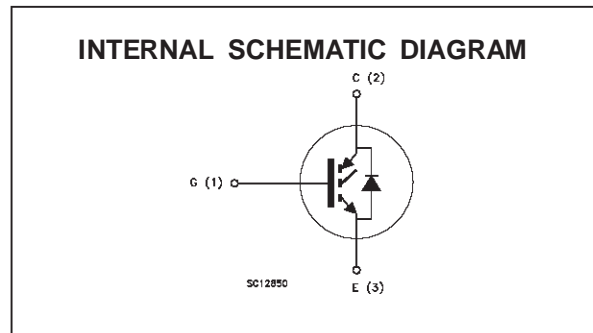
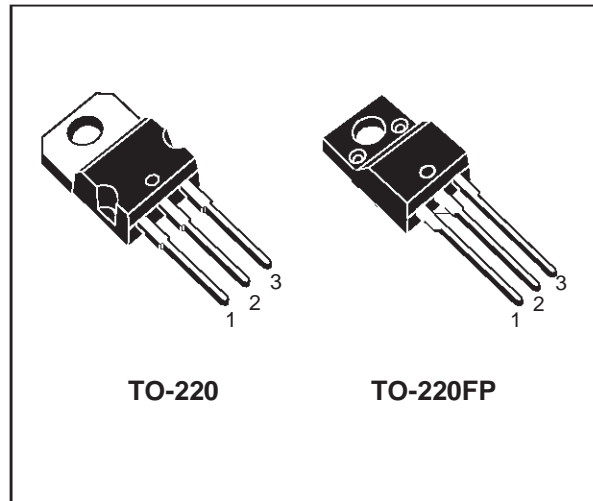
- HIGH INPUT IMPEDANCE (VOLTAGE DRIVEN)
- LOW ON-VOLTAGE DROP (V<sub>cesat</sub>)
- LOW GATE CHARGE
- HIGH CURRENT CAPABILITY
- VERY HIGH FREQUENCY OPERATION
- OFF LOSSES INCLUDE TAIL CURRENT
- CO-PACKAGED WITH TURBOSWITCH™ ANTIPARALLEL DIODE

## DESCRIPTION

Using the latest high voltage technology based on a patented strip layout, STMicroelectronics has designed an advanced family of IGBTs, the PowerMESH™ IGBTs, with outstanding performances. The suffix "H" identifies a family optimized to achieve very low switching times for high frequency applications (<120kHz).

## APPLICATIONS

- HIGH FREQUENCY MOTOR CONTROLS
- SMPS AND PFC IN BOTH HARD SWITCH AND RESONANT TOPOLOGIES



## ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		STGP7NB60HD	STGP7NB60HDFP	
V <sub>CES</sub>	Collector-Emitter Voltage (V <sub>GS</sub> = 0)	600	600	V
V <sub>GE</sub>	Gate-Emitter Voltage	± 20	± 20	V
I <sub>C</sub>	Collector Current (continuous) at T <sub>c</sub> = 25 °C	6	6	A
I <sub>C</sub>	Collector Current (continuous) at T <sub>c</sub> = 100 °C	3	3	A
I <sub>CM</sub> (•)	Collector Current (pulsed)	24	24	A
P <sub>tot</sub>	Total Dissipation at T <sub>c</sub> = 25 °C	70	35	W
	Derating Factor	0.56	0.28	W/°C
T <sub>stg</sub>	Storage Temperature	-65 to 150		°C
T <sub>j</sub>	Max. Operating Junction Temperature	150		°C

(•) Pulse width limited by max. junction temperature

## THERMAL DATA

			TO-220	TO-220FP	
$R_{thj-case}$	Thermal Resistance Junction-case	Max	1.78	3.57	$^{\circ}\text{C/W}$
$R_{thj-amb}$	Thermal Resistance Junction-ambient	Max	62.5		$^{\circ}\text{C/W}$
$R_{thc-sink}$	Thermal Resistance Case-sink	Typ	0.5		$^{\circ}\text{C/W}$

ELECTRICAL CHARACTERISTICS ( $T_j = 25^{\circ}\text{C}$  unless otherwise specified)

## OFF

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{BR(CEs)}$	Collector-Emitter Breakdown Voltage	$I_C = 250\ \mu\text{A}$ $V_{GE} = 0$	600			V
$I_{CES}$	Collector cut-off ( $V_{GE} = 0$ )	$V_{CE} = \text{Max Rating}$ $T_j = 25^{\circ}\text{C}$ $V_{CE} = \text{Max Rating}$ $T_j = 125^{\circ}\text{C}$			100 1000	$\mu\text{A}$ $\mu\text{A}$
$I_{GES}$	Gate-Emitter Leakage Current ( $V_{CE} = 0$ )	$V_{GE} = \pm 20\ \text{V}$ $V_{CE} = 0$			$\pm 100$	nA

## ON (\*)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{GE(th)}$	Gate Threshold Voltage	$V_{CE} = V_{GE}$ $I_C = 250\ \mu\text{A}$	3		5	V
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage	$V_{GE} = 15\ \text{V}$ $I_C = 3\ \text{A}$ $V_{GE} = 15\ \text{V}$ $I_C = 3\ \text{A}$ $T_j = 125^{\circ}\text{C}$		2.4 1.9	2.8	V V

## DYNAMIC

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$g_{fs}$	Forward Transconductance	$V_{CE} = 25\ \text{V}$ $I_C = 3\ \text{A}$	1.3	2.4		S
$C_{ies}$ $C_{oes}$ $C_{res}$	Input Capacitance Output Capacitance Reverse Transfer Capacitance	$V_{CE} = 25\ \text{V}$ $f = 1\ \text{MHz}$ $V_{GE} = 0$	160 23 4.5	235 33 6.6	300 43 8.6	pF pF pF
$Q_G$ $Q_{GE}$ $Q_{GC}$	Total Gate Charge Gate-Emitter Charge Gate-Collector Charge	$V_{CE} = 480\ \text{V}$ $I_C = 3\ \text{A}$ $V_{GE} = 15\ \text{V}$		21 6 7.6	27	nC nC nC
$I_{CL}$	Latching Current	$V_{clamp} = 480\ \text{V}$ $R_G = 10\ \Omega$ $T_j = 150^{\circ}\text{C}$	12			A

## SWITCHING ON

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ $t_r$	Delay Time Rise Time	$V_{CC} = 480\ \text{V}$ $I_C = 3\ \text{A}$ $V_{GE} = 15\ \text{V}$ $R_G = 10\ \Omega$		16 30		ns ns
$(di/dt)_{on}$	Turn-on Current Slope	$V_{CC} = 480\ \text{V}$ $I_C = 3\ \text{A}$ $R_G = 10\ \Omega$ $V_{GE} = 15\ \text{V}$		400		A/ $\mu\text{s}$
$E_{on(\gamma)}$	Turn-on Switching Losses	$T_j = 125^{\circ}\text{C}$		77		$\mu\text{J}$

**ELECTRICAL CHARACTERISTICS** (continued)**SWITCHING OFF**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_c$	Cross-Over Time	$V_{CC} = 480\text{ V}$ $I_C = 3\text{ A}$		90		ns
$t_r(V_{off})$	Off Voltage Rise Time	$R_{GE} = 10\ \Omega$ $V_{GE} = 15\text{ V}$		36		ns
$t_d(off)$	Delay Time			53		ns
$t_f$	Fall Time			70		ns
$E_{off}(^{**})$	Turn-off Switching Loss			33		$\mu\text{J}$
$E_{ts}(^{\circ})$	Total Switching Loss			100		$\mu\text{J}$
$t_c$	Cross-Over Time	$V_{CC} = 480\text{ V}$ $I_C = 3\text{ A}$		180		ns
$t_r(V_{off})$	Off Voltage Rise Time	$R_{GE} = 10\ \Omega$ $V_{GE} = 15\text{ V}$		82		ns
$t_d(off)$	Delay Time	$T_j = 125\text{ }^{\circ}\text{C}$		58		ns
$t_f$	Fall Time			110		ns
$E_{off}(^{**})$	Turn-off Switching Loss			88		$\mu\text{J}$
$E_{ts}(^{\circ})$	Total Switching Loss			165		$\mu\text{J}$

**COLLECTOR-EMITTER DIODE**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$I_f$	Forward Current				3	A
$I_{fm}$	Forward Current pulsed				24	A
$V_f$	Forward On-Voltage	$I_f = 3\text{ A}$		1.6	2.0	V
		$I_f = 3\text{ A}$ $T_j = 125\text{ }^{\circ}\text{C}$		1.4		V
$t_{rr}$	Reverse Recovery Time	$I_f = 3\text{ A}$ $V_R = 200\text{ V}$		87		ns
$Q_{rr}$	Reverse Recovery Charge	$dI/dt = 100\text{ A}/\mu\text{S}$ $T_j = 125\text{ }^{\circ}\text{C}$		160		nC
$I_{rrm}$	Reverse Recovery Current			3.7		A

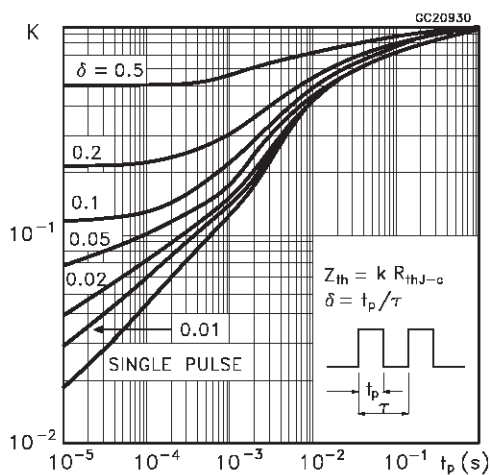
(●) Pulse width limited by max. junction temperature

( $\circ$ ) Include recovery losses on the STTA306 freewheeling diode

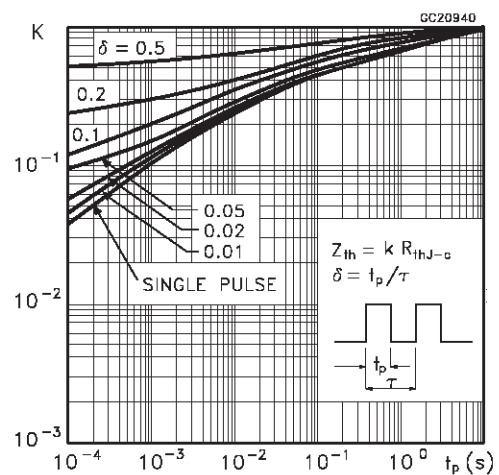
(\*) Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5 %

(\*\*) Losses Include Also The Tail (Jedec Standardization)

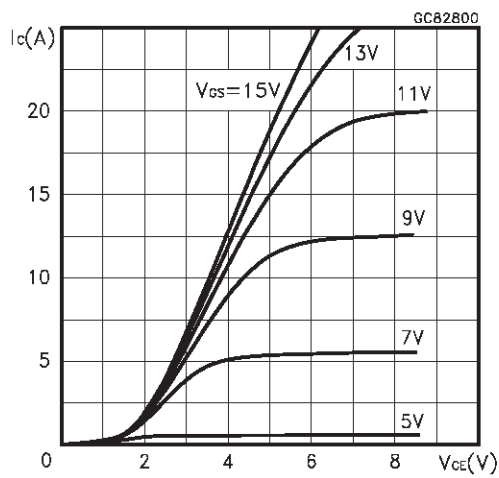
Thermal Impedance For TO-220



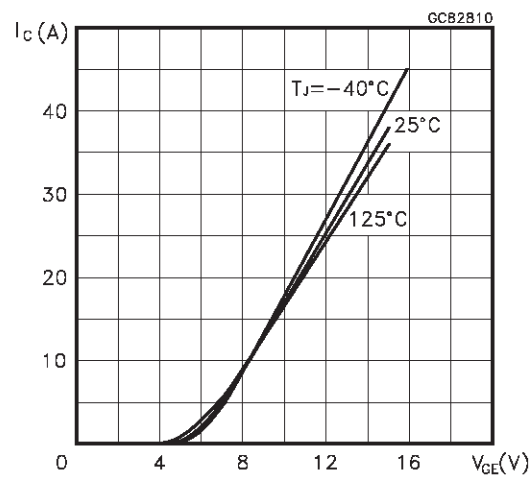
Thermal Impedance For TO-220FP



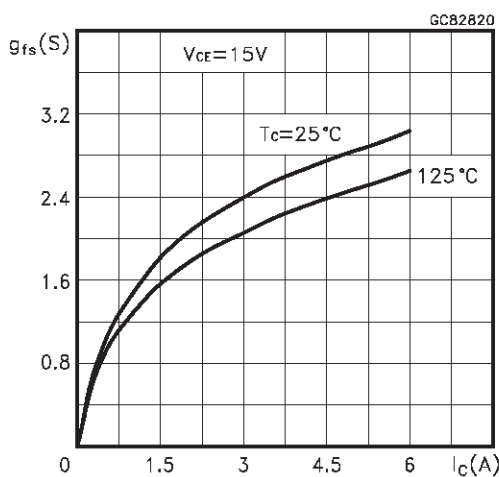
Output Characteristics



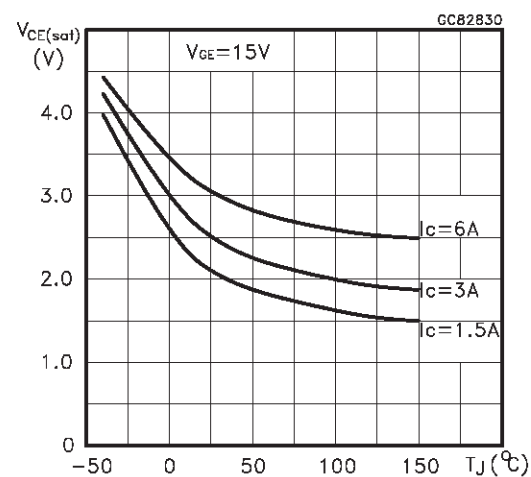
Transfer Characteristics



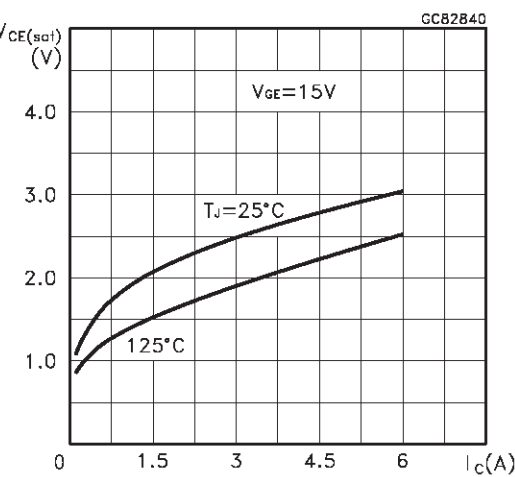
Transconductance



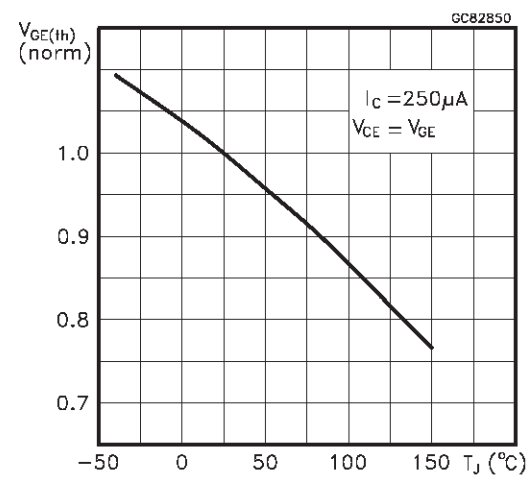
Collector-Emitter On Voltage vs Temperature



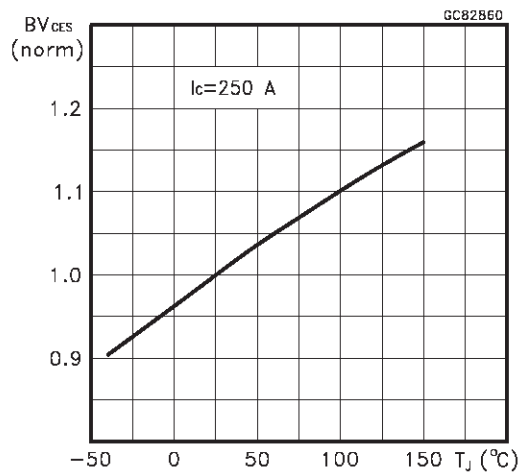
Collector-Emitter On Voltage vs Collector Current



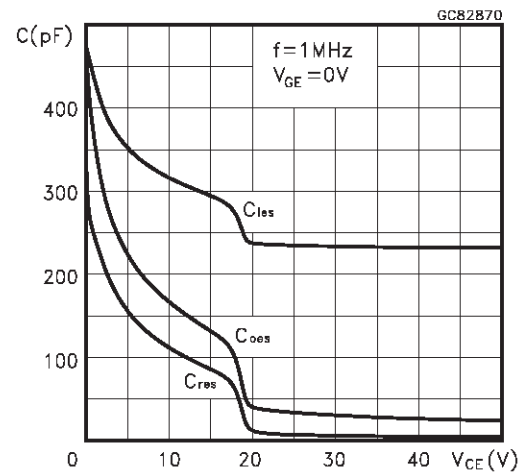
Gate Threshold vs Temperature



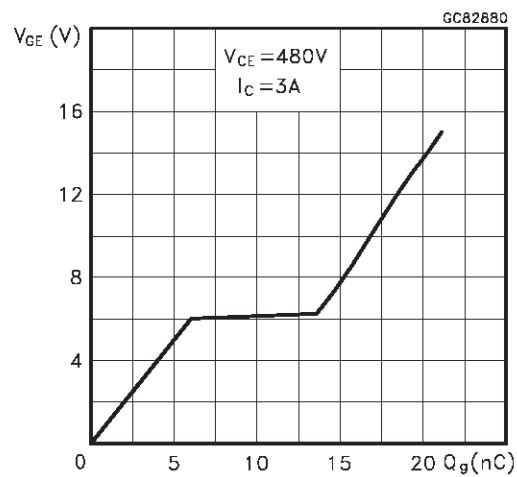
Normalized Breakdown Voltage vs Temperature



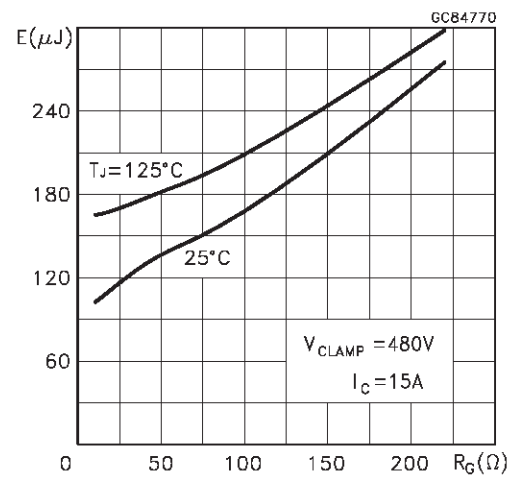
Capacitance Variations



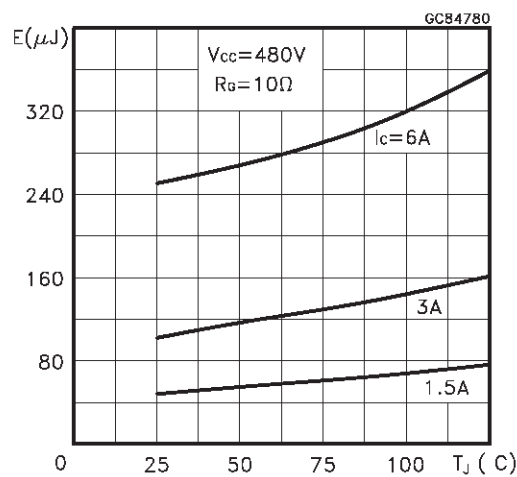
Gate Charge vs Gate-Emitter Voltage



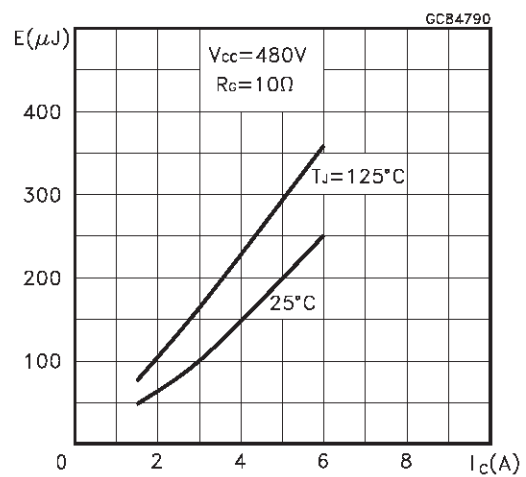
Total Switching Losses vs Gate Resistance



Total Switching Losses vs Temperature



Total Switching Losses vs Collector Current



Switching Off Safe Operating Area

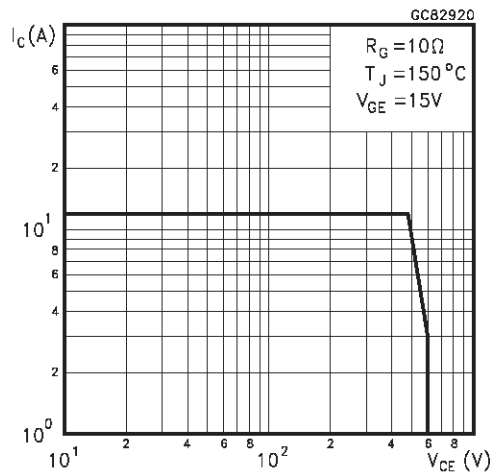


Fig. 1: Gate Charge test Circuit

Diode Forward Voltage

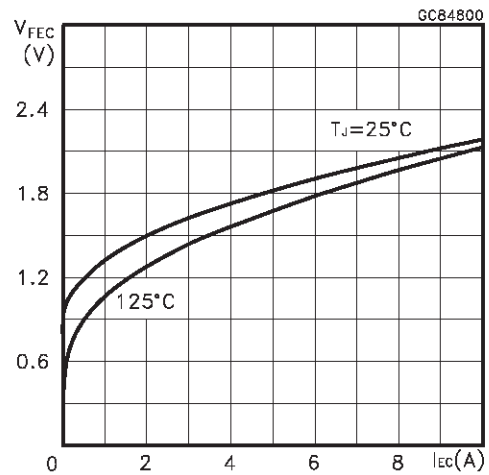


Fig. 2: Test Circuit For Inductive Load Switching

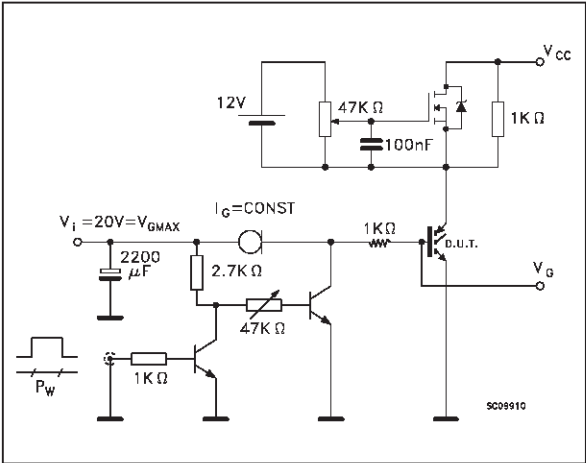
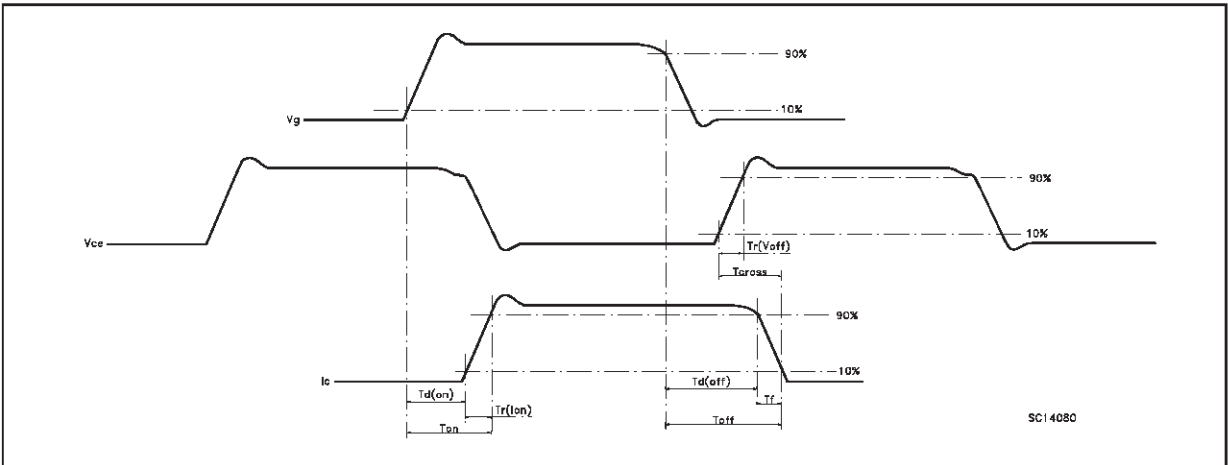
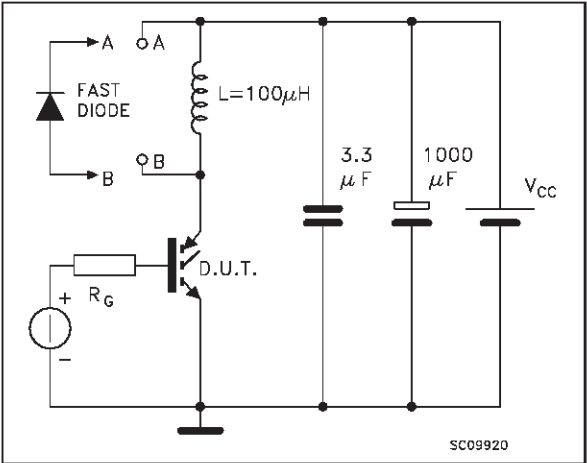
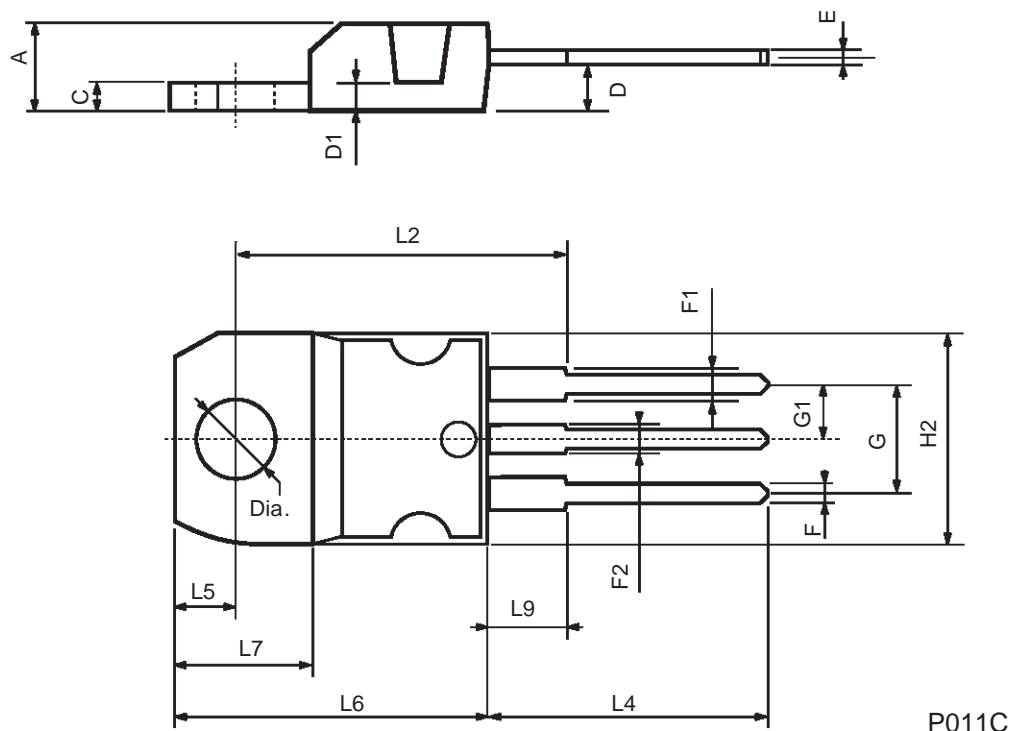


Fig. 3: Switching Waveforms



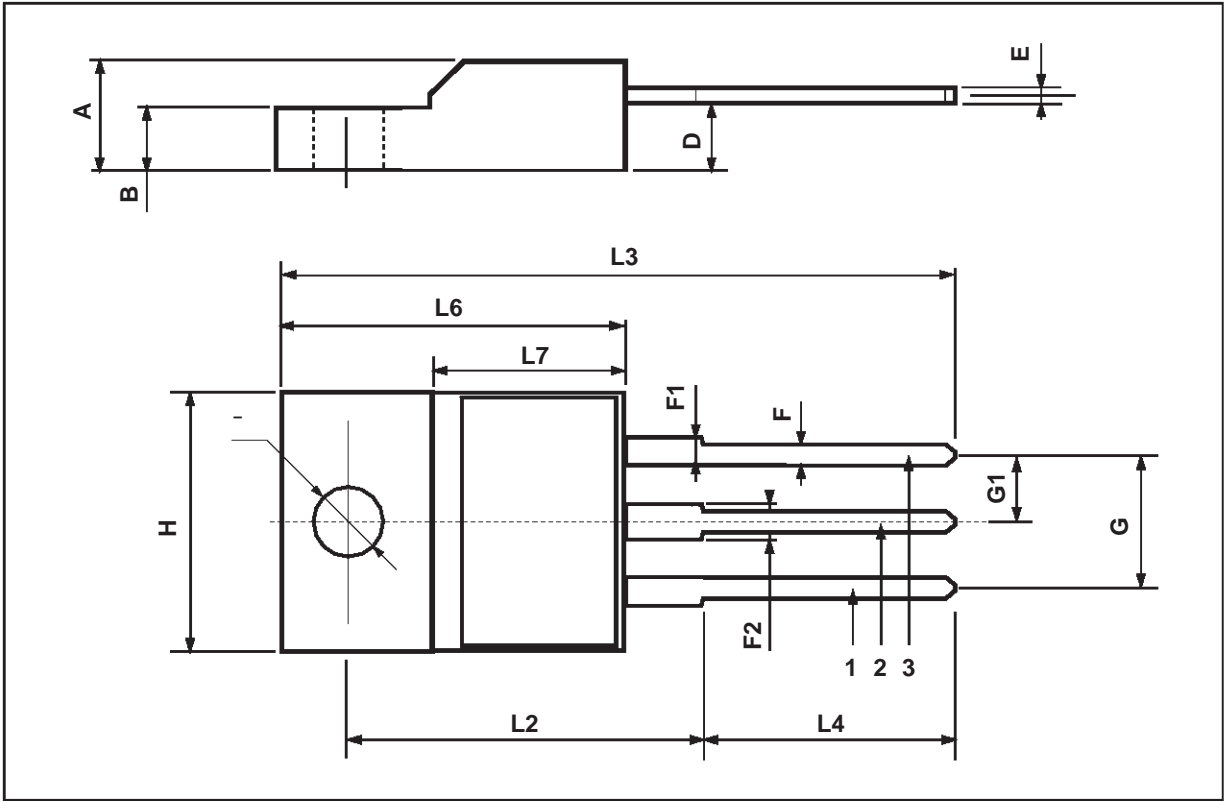
## TO-220 MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.40		4.60	0.173		0.181
C	1.23		1.32	0.048		0.051
D	2.40		2.72	0.094		0.107
D1		1.27			0.050	
E	0.49		0.70	0.019		0.027
F	0.61		0.88	0.024		0.034
F1	1.14		1.70	0.044		0.067
F2	1.14		1.70	0.044		0.067
G	4.95		5.15	0.194		0.203
G1	2.4		2.7	0.094		0.106
H2	10.0		10.40	0.393		0.409
L2		16.4			0.645	
L4	13.0		14.0	0.511		0.551
L5	2.65		2.95	0.104		0.116
L6	15.25		15.75	0.600		0.620
L7	6.2		6.6	0.244		0.260
L9	3.5		3.93	0.137		0.154
DIA.	3.75		3.85	0.147		0.151



TO-220FP MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.4		4.6	0.173		0.181
B	2.5		2.7	0.098		0.106
D	2.5		2.75	0.098		0.108
E	0.45		0.7	0.017		0.027
F	0.75		1	0.030		0.039
F1	1.15		1.7	0.045		0.067
F2	1.15		1.7	0.045		0.067
G	4.95		5.2	0.195		0.204
G1	2.4		2.7	0.094		0.106
H	10		10.4	0.393		0.409
L2		16			0.630	
L3	28.6		30.6	1.126		1.204
L4	9.8		10.6	0.385		0.417
L6	15.9		16.4	0.626		0.645
L7	9		9.3	0.354		0.366
Ø	3		3.2	0.118		0.126





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